Space Weather Technical Forecast

Issued on Wednesday, 23 March 2022 at 13:23 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of elevated geomagnetic activity on Thursday due to coronal holes. Otherwise, mainly quiet.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours, with occasional C-class flares, peaking at C7 at 22/1242 UTC associated with a sunspot region rotating around from the northeast limb. There are currently two numbered sunspot regions on the visible disc, AR2972 (Bxo/Beta) which is fading rapidly, and AR2974 in the southeast which appears to be showing some minor growth. There are also two unnumbered sunspot regions on the disc, one in the southwest, which is currently classified as a Cro/Beta, and the second is located in the northeast, which is rotating into view and appears to be the largest (hard to currently analyse). A prominence was seen to erupt slowly off the northeast limb of the disc around 22/1700UTC, with a slow CME which is not directed at Earth.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by DSCOVR at L1, was slightly elevated through the period, starting at 450km/s yesterday, decreasing rapidly to 300km/s during the afternoon, before rising steadily again to around 400km/s today. Density was mostly averaging between 8-10ppcc. The Phi angle was mostly positive (away from the sun), but has recently started turning more negative, which may hint towards CH66/- influence. The IMF peaked at 11nT at 22/2000UTC, with a north-south component range between -6 and +8nT and a somewhat erratic tendency between these extremes. Geomagnetic activity as a result of the above solar parameters was mostly Quiet (Kp1-2), with a couple of Unsettled (Kp 3) intervals at 22/1800-2100 UTC and 23/0900-1200UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) measured at GOES 16 were at background levels. The high energy electron flux (greater than 2 MeV) has been at Normal Background levels, and the 24-hour integrated electron fluence was well below the Active (1e8 integrated pfu) threshold, on a steady trend. Observed fluence at 23/0000UTC was 1.42e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to continue Low, with a 60% likelihood of further isolated C-class flares and a 15% slight chance of isolated M-class flares, with most of activity likely associated with sunspot regions now rotating into view on the eastern horizon.

Solar Wind / Geomagnetic Activity: There is one possible weak Earth-directed CME in the forecast, potentially giving Earth a glancing blow on late Day 2 (24 March). There is also a likelihood of a slight coronal hole fast wind due on the same day, perhaps early on. Separately, these events are not likely to be significant, but will encourage geomagnetic activity, perhaps to Active (Kp4) with a decreasing trend through Day 3 onwards (25 March). Geomagnetic activity should therefore be mainly Quiet throughout the period with a likelihood of Unsettled or Active (Kp3-4) periods on Day 2.

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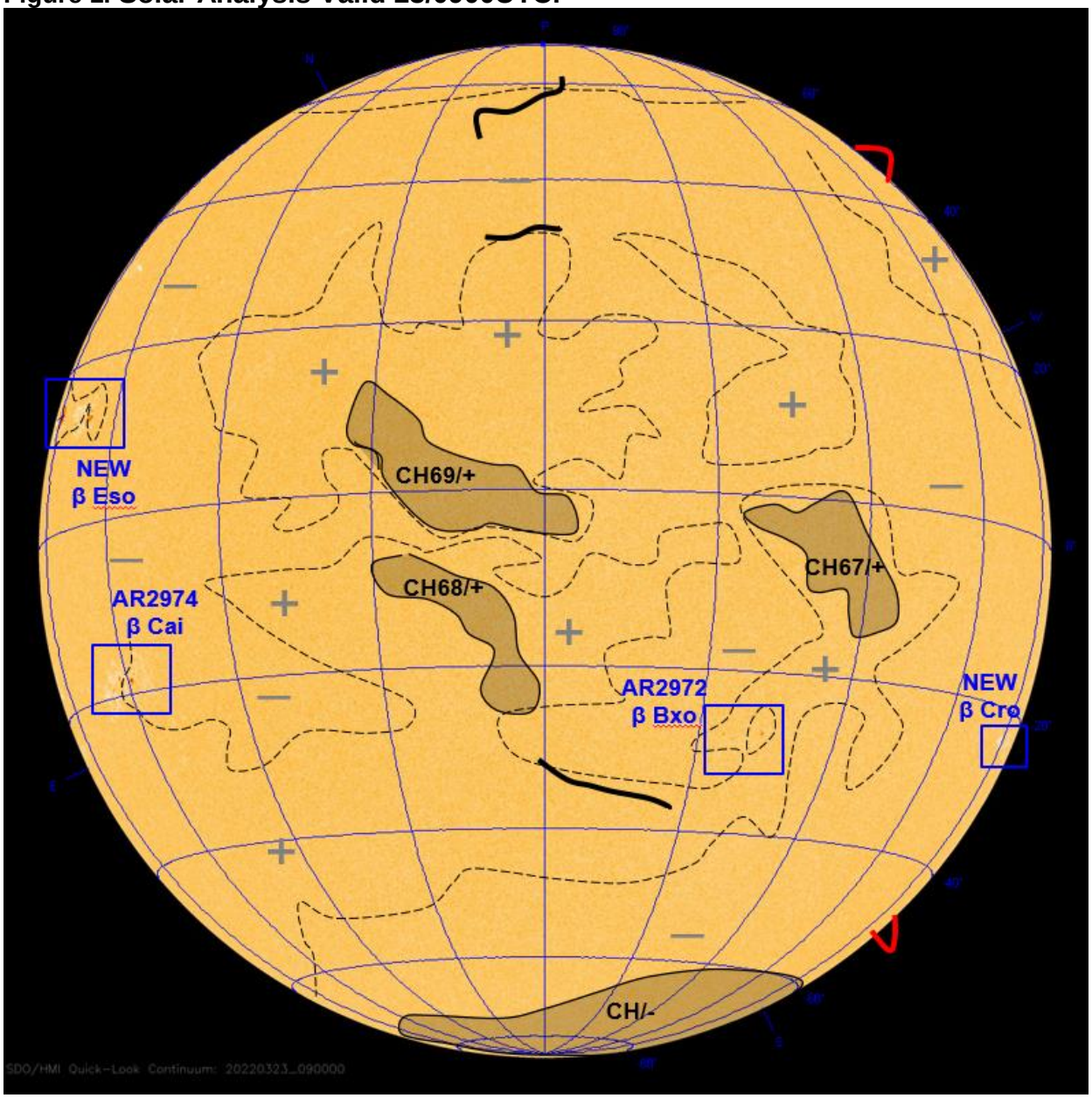
Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to be at Background levels throughout the forecast period. The high energy (greater than 2 MeV) electron flux is currently at Normal Background levels, and is unlikely to increase in the near-term. A rise in flux and 24-hour integrated fluence levels is possible later in the period after the potential CME and coronal hole fast wind arrivals, but perhaps not to the active threshold. Fluence levels are therefore most likely to stay well below the Active (1e8 integrated pfu) threshold throughout.

Figure 1. Solar Analysis Valid 23/0900UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

The solar wind has been slightly elevated and erratic over the last 24 hours, suggesting a transient feature of some sort has passed through, or perhaps a weak coronal hole fast wind. This has only resulted in occasionally Unsettled Geomagnetic activity. There is one possible slow Earth-directed CME in the forecast, associated with the 20/0745UTC C4.6 flare which emerged from the plage remnant of Ex-2971 in the northeast quadrant. This has been assessed and there is a slight chance of a glancing blow at Earth on day 2 (24 March), probably late in the UTC day. No other Earth-directed CMEs feature in the forecast.

There is also one non-persistent coronal hole high speed stream due tomorrow (24th March) from CH67/+ west of centre disc. This is both small and of positive polarity, and effects are likely to be muted as positive coronal holes are not favoured for a geomagnetic response at this time of year. However, the combination of the possible CME and coronal hole fast wind may give a slightly enhanced response, most likely up to Active (Kp4). STEREO-A data is currently inconclusive at hinting what the expected character of CH67 is.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	10	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
20/03/2022	Partial	Plage from Ex-2971	N09 E020	210km/s	24/2300 UTC	Slow CME directed towards NE following C4 flare.

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Radio Blackouts - X-Ray Flares:

Solar activity has been Low over the past 24 hours, with occasional C-class flares, peaking at C7 at 22/1242 UTC, which appears to have originated from a sunspot region currently rotating around from the east limb. There are 4 regions in total, two of which are about to disappear.

The daily probability of M-class flares is judged at a Slight Chance (15%) throughout, largely as a result of the appearance of newly-numbered AR2974 in the southeastern quadrant and another sizable region in the northeast, which is beginning to show some flaring activity.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	15	15	15	15
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (10MeV) measured at GOES-16 is expected to remain at background levels throughout the forecast period.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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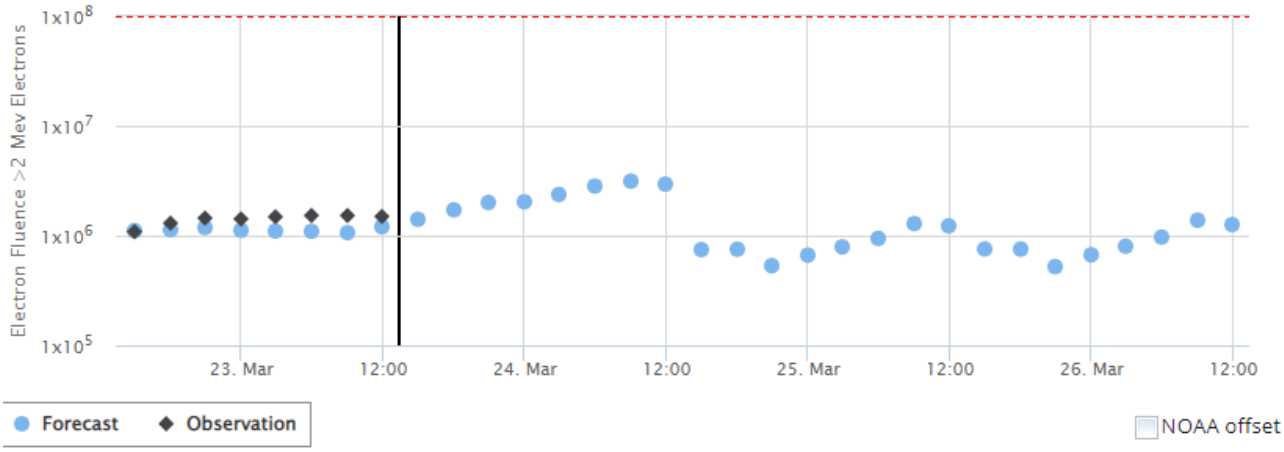
High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux as observed at GEO by GOES-16 is currently at Normal Background levels, with any significant enhancement in the near-term unlikely.

However, due to the uncertainty with waning effects of any coronal hole(s) influence, there is a slight chance of some enhancement from Day 2 (24 March). There is unlikely to be any significant geomagnetic response from the weak CH influence, so unlikely to raise electron levels enough to reach the Active (1e8 integrated pfu) fluence threshold in the forecast period. The general trend on MOSWOC REFM is currently flat and well below Active, which is accepted.

GEO Electron Environment	Level ($cm^{-2}\ sr^{-1}\ day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	5	10	5
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 3: Latest Met Office REFM observations and forecast



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